Consolidated Systems Gateway Subsystem Design Review

February 27, 1997

Version 1.0

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1. Overview

The Consolidated Systems Gateway provides CLCS access to CCMS I data via the Shuttle Data Stream. Each Consolidated Systems (CS) Gateways will be able to source one or all existing LPS data links (PCM D/L, GSE, LDB). In addition to the existing CCMS sources, the CS Gateway will also provide access to LC-39 Pacd Meteorological (Metro) Data and Ground Measurement System (GMS) data. The data will be provided to CLCS via the Real Time Critical Network (RTCN). This will allow CLCS access to real or simulated (via SGOS) CCMS data for DDP, CCP and HCI development prior to the deployment of CLCS Gateways (i.e. LDB, PCM, GSE). As CLCS Gateways are deployed, individual data sources (i.e. PCM D/L, etc.) will be selectively de-activated. However, Metro and GMS data will always be provided to CLCS by the CS Gateway.

2. Consolidated Systems Gateway Requirements

Note: All references to 'Gateway' in this section refer to the Consolidated Systems Gateway

- The Gateway will receive Meteorological data via an Ethernet interface to the Consolidated SDS Gateway in the LCC.
- Floating Point Meteorological data received from the to LC-39 Meteorological Data System will be converted to Modcomp Floating Point.
- The Gateway will perform Surface Ice (SURFICE) calculations.
- During the initialization, the Gateway will process an LC-39 Meteorological Data System configuration file and a SURFICE configuration file.
- The Gateway will receive Ground Measurement System (GMS) data via the Consolidated Systems Gateway located in the LCC.
- Floating Point GMS data received from the to GMS System will be converted to Modcomp Floating Point.
- During the initialization, the Gateway will process GMS Configuration Files provided electronically by the file server by GMS Operations.
- The Gateway will perform linearization of GMS Data as required.
- The Gateway will receive GMT via an IRIG-B input.
- The Gateway will be output Change Data Packets as a single stream based on a timer that is normally 10msec, but can be varied from 5msec to 100msec.
- The Gateway will output DDP Data as a single stream based on a timer that is normally 100msec, but can be varied from 50msec to 1 second.
- During initialization, the Gateway is required to:
  - Read in the TCID for the selected data stream.
    - If the correct TCID is not online, output error message and stop the process.
  - Initialize the status table for all FDs.
  - Read in the FD-to-RTCN ID file and initialize the status table for those FDs supplied.
  - Read in the FEP-to-Q file that specifies which queue a FEP's data goes into.
    - Read multicast data packets from the selected data stream.
      - Verify the packet data checksum and other header information.

    - If bad, ignore the packet.
  - Verify the packet sequence number.
    - If bad, output message.
  - Parse the SDS packet.
    - Place the data in the proper DDP queues with the correct GMT.
    - Place the data in the Consolidated-10 and Consolidated-100 queues with the correct GMT.
- If a queue timer expires.
  - Output data for that queue or empty packet if queue is empty.
- Read multicast status packets from the selected data stream.
  - Verify the packet header information.
    - if bad, ignore the packet.
  - Verify the packet TCID name.
    - if changed, restart the process.

3. Consolidated Systems Gateway Performance Requirements

- METRO will process all LC-39 Metro System data as it arrives.
- METRO will store received Metro. System data in a FIFO for passing to the Augment SDS Process at an update rate of once per second.
- METRO will calculate Surface Ice formation/melting rates at one minute intervals.
- GMS will process all GMS/ PMS data as it arrives.
- GMS will store received GMS/ PMS data in a FIFO for passing to the CCMS Measurement Extractor/RTCN Packet Builder CSC at a maximum update rate of twice per second.
- The Gateway must be able to handle the total of the following packet rates or 150 total packets per second, whichever is greater.
  - The peak SDS packet rate (currently about 50 packets per second).
  - Twice the peak of the merge packets from the all the data providers.
  - Twice the peak of the merge packets from six other data providers

4. Consolidated Systems Gateway Ground Rules

- The Network Services CSCI will be used to output all data packets.
- There will be no filtering for changed data output on the RTCN.
- When data is received containing packed discretes, the data will be output on the RTCN individually, whether the discrete has have changed or not.
- For JUNO, a measurement’s address on the RTCN will be the sum of the lengths of all FDs before it
- For JUNO, a table will be used to hold the measurement’s health, status and 100usec tag. This table is initialized by the FD-to RTCN ID file and can be modified by the console during run-time.
- More than one FEP’s data can be placed in an individual DDP queue based on the FEP-to-Q file.
- FD-to-RTCN ID file is provided in ASCII.

- FEP-to-Q file is provided in ASCII.
- For JUNO, if there is not enough processing power to support the Metro and GMS CSCs, Metro and GMS data will be provided to the RTCN via the SDS'
- For JUNO, the user interface will be provided via a Telnet Session.
- For JUNO, only one RTCN Adapter Board will be installed.

5. Consolidated Systems Gateway Architecture

A high-level architecture diagram showing major system components and data flows is shown in Figure 1. Figure 1 illustrates the basic hardware deployment for the Satellite development environments in the EDL and PCC. The CS Gateways will receive SDS, SDS', Metro and GMS from the Consolidated SDS Gateways located in the LCC via Ethernet (SODN and LON). The CS Gateways will process the data for transmission the RTCN/DCN via ATM. The work station will provide a user interface to the CS Gateway.

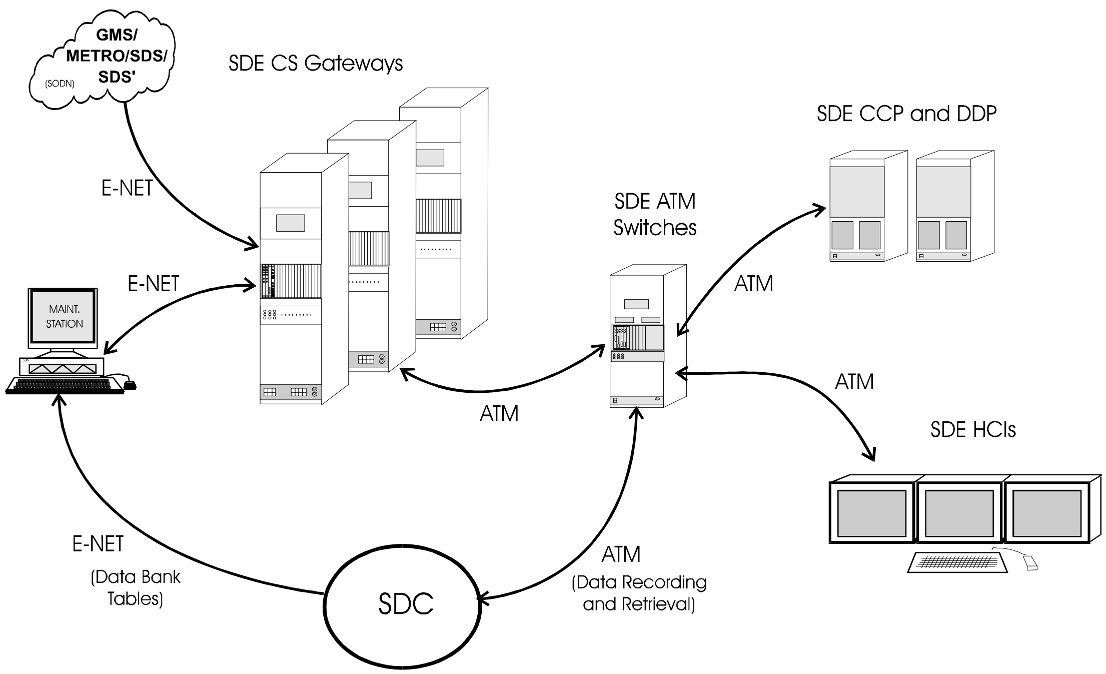

Figure 1: SDE Consolidated Systems Gateway SDE Configuration Diagram

Each Consolidated Systems Gateway is comprised of a standard 19 inch equipment rack, touch screens, and a VME System (Figure 2).

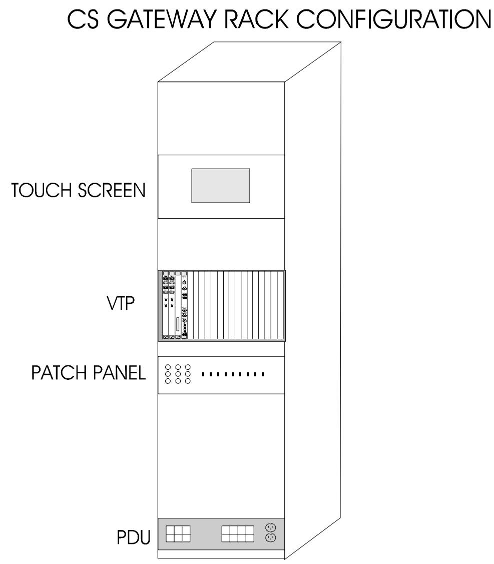

Figure 2: Consolidated Systems Gateway Rack Configuration

The VME System houses the data processing equipment and is refered to as the VME Telemetry Processor (VTP).

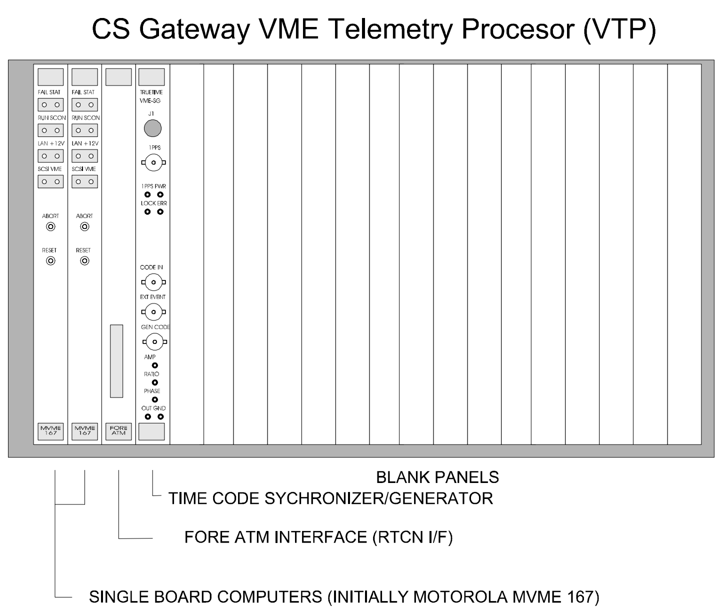

Figure 3: VME Telemetry Processor

The major components and data flows in the VME Telemetry Processor are shown in Figure 4. There are a total of two processors in the system. The first processor in the system is the Gateway Control Processor (GCP) and is the VME system controller. The Gateway System manager Process runs only on the GCP. The remaining Processor is referred to as Front End Process Controller (FEPC). The Metro, GMS, CCMS Measurement Extraction/RTCN Packet Builder CSCs run olnly on the FEPC.

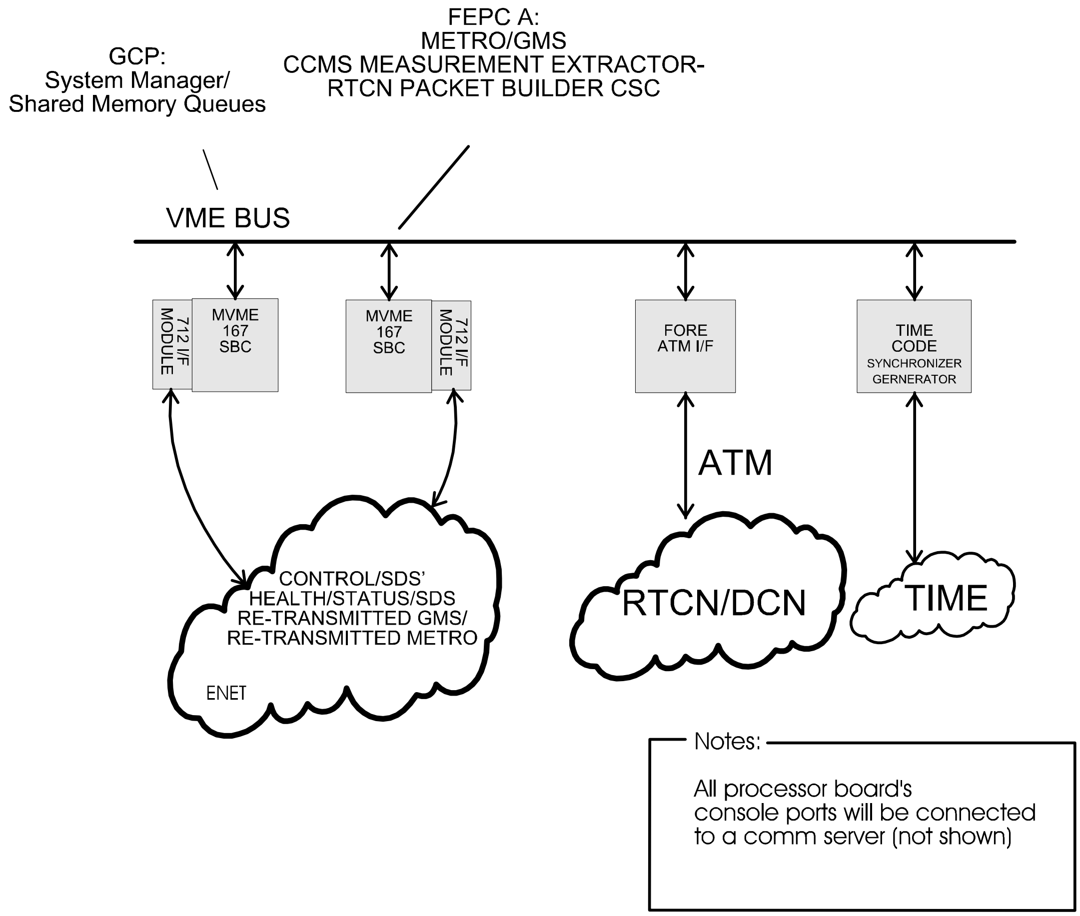

Figure 4: VME Component Diagram

6. Consolidated Systems Gateway HWCIs

As was previously stated, the Consolidated Systems Gateway consists of a 19 inch equipment rack that houses the VME Telemetry Processor and other associated support hardware. The following tables lists of the major Hardware Configurable Items (HWCIs) that comprise the Consolidated Systems Gateway:

HWI Name	Implementation	GOTS/COTS/Custom
Rack	CORE	GOTS
VME Telemetry Processor		
VME Chassis	CORE	GOTS
GCP	MVME 167	COTS
FEPC	MVME 167	COTS
Transition Modules	MVME 712	COTS
RTCN Adapter Board	FORE Systems VME ATM	COTS
IRIG B Decoder	TRUETIME VME SG-2	COTS
Touch Screen	Emerald Computer	GOTS
Patch Panel		GOTS
Comm Server	CORE	COTS
Power Distribution Panel	CORE	GOTS

Table 1: Consolidated Systems CIs

6.1 Consolidated Systems Gateway Rack

The Consolidated Systems Gateway Rack houses all CIs used in the Consolidated Systems Gateway. The rack was obtained from the CORE residual inventories available onsite at KSC. The rack is a standard 19 inch assembly.

6.2 VME Chassis

The VME Chassis was obtained from CORE residuals on hand at KSC. It is a custom 21 slot chassis with a 115V 1000 watt power supply. Additional slots are provided in the rear for special I/O boards. The Gateway does not require this custom chassis. Most COTS VME chassis will satisfy all Gateway Chassis requirements.

6.3 Gateway Control Processor (GCP)

The Gateway Control Processor is implemented with a Motorola MVME 167 Single Board Computer. The board is based on a Motorola 68040 microprocessor operating at 33 MHz. The board has 8 megabytes of on-board DRAM, 4 serial ports, an Ethernet interface, a SCSI interface, and a VME Bus interface. Details about the single board computer can be found in *the MVME 167 Single Board Computer Manual*.

6.4 Front End Process Controller

The Front End Process Controller is implemented with a Motorola MVME 167 Single Board Computer. The board is based on a Motorola 68040 microprocessor operating at 33 MHz. The board has 8 megabytes of on-board DRAM, 4 serial ports, an Ethernet interface, a SCSI interface, and a VME Bus interface. Details about the single board computer can be found in *the MVME 167 Single Board Computer Manual*.

6.5 RTCN Adapter Board

The RTCN Adapter Board provides an ATM interface between the Gateway VTP and the RTCN. It is implemented with a FORE systems VME ATM Board. For more information, reference the *FORE Systems ATM VME Adapter Board Users Manual.*

6.6 Transition Module

The transition module is implemented with a Motorola MVME712M and is used to interface between the MVME 167 family single board computers and the peripheral devices (serial ports, SCSI ports, etc.). A P2 adapter module and cables provide the connectivity between the 167 board and the transition module. Additional information about the transition module may be found in the *MVME 712M Transition Module Users Manual*.

6.7 IRIG B Decoder

The IRIG B decoder is implemented with a TrueTime Model 560-5608 VME-SG. The board decodes an IRIG-B signal and provides GMT to the Gateway via the VME bus. For more information anout the VME-SG, reference the *TrueTime VME-SG Users Manual*.

6.8 Touch Screen

The Touch Screen provides a maintenance interface to the SDS Gateway. The Touch Screen will be mounted in the rack above the VTP. Communication with the touch screen is provided via an RS-232 serial port connected to the GCP.

6.8.1.1 Patch Panel

The Patch Panel is not used in this Gateway.

6.9 Power Distribution Panel

The Power Distribution Panel provides AC power to the rack via three phase facility power available in the LCC.

6.10 Comm Server

The Comm server provides access to the serial ports on the GCP and FEPCs via Ethernet. For for more information reference the Datability VCP 1000 Users Manual.

7. Consolidated Systems CSCI

The Consolidated Systems Gateway CSCI is composed of several CSCs written in the C programming language for the VxWorks Operating System. The context diagram is shown in Figure 5.

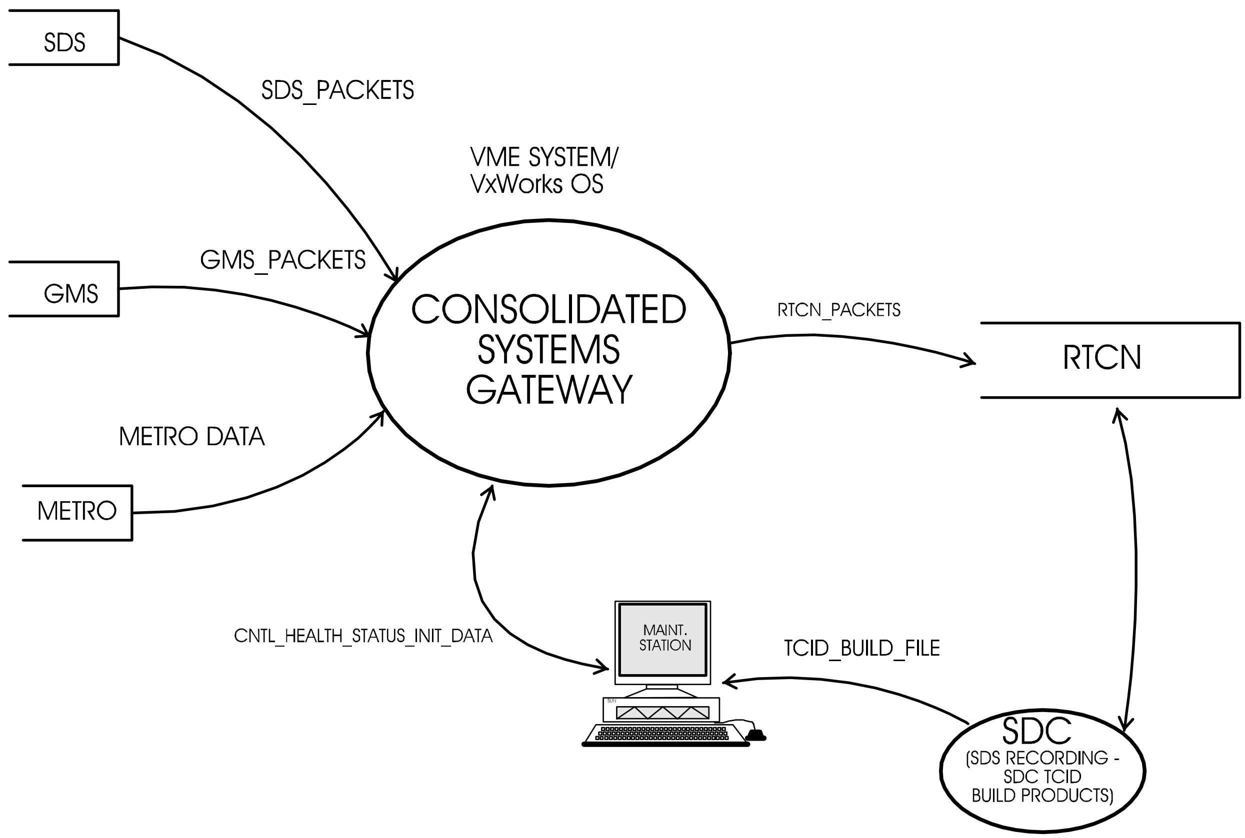

Figure 5: Context Diagram

The Consolidated Systems Gateway Services CSCI is composed of several CSCs running on both the Gateway Control Processor and the four Front End Control Processor. A summary is shown in Table 2.

CSC	Function	Processor
Gateway System Manager	System initialization, Control, Health, Status, Hard disc access.	GCP
Metro	Process Data from Pad Meteorological System	FEPC
GMS	Process Data from the Ground Measurement System	FEPC
CLCS FDID Builder	Create CLCS FDIDs	Off-line (PC)
CCMS Measurement Extractor/RTCN Packet Builder	Retrieves CCMS measurements from the SDS and build CLCS RTCN Packets.	FEPC

Table 2: Consolidated SDS Gateway CSCs

7.1 Gateway Control Processor CSC - Gateway System Manager

The Gateway System Manager resides on the Gateway Control Processor described in the Sections 3 and 4. The Gateway System Manager provides the essential functions to the Gateway operational. It is resident in the Gateway Control Processor (GCP). The Gateway System Manager is composed of multiple concurrent tasks that perform individual functions in order to support all the resources in the Gateway.

The Gateway System Manager is initiated by the Real Time Operating Systems (RTOS) loaded from an external hard drive. Initially it will spawn all the necessary tasks to support the Gateway services. Some of these tasks will perform health & status of the Gateway hardware resources, health & status of the other active tasks, control of the external interfaces (front panel, Ethernet port, serial ports), initialization of shared memory objects, initialization of the Front End Control Processor (FEPC), loading of the build products, and disk utilities.

7.1.1 Gateway System Manager Data Flow Diagram

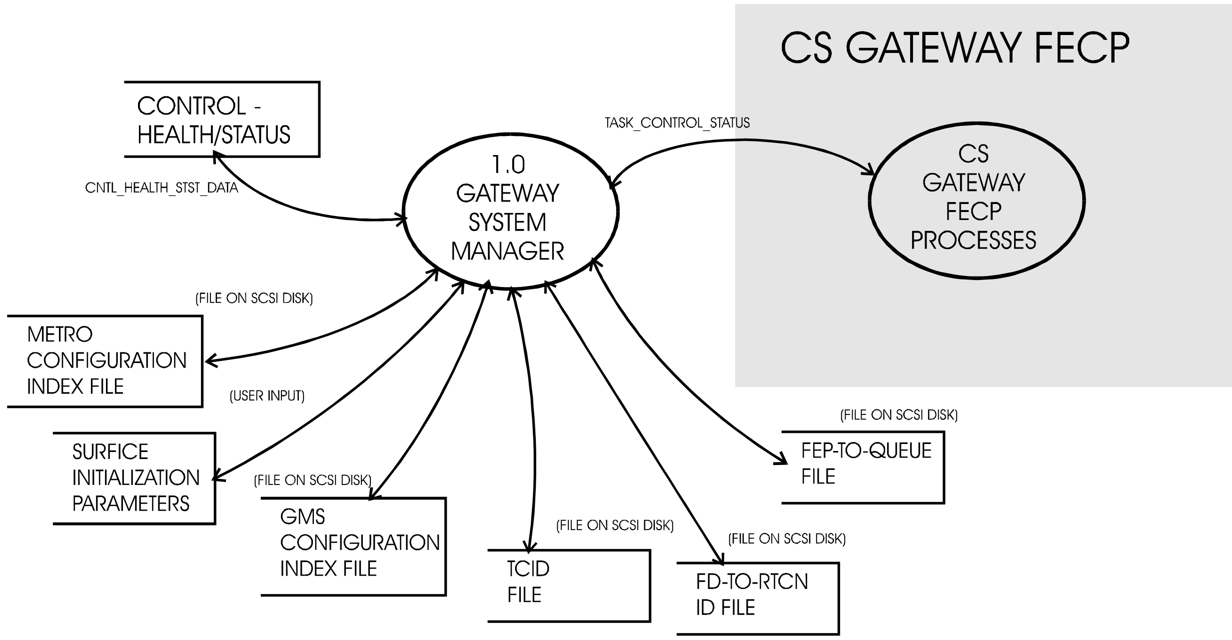

Figure 6: Gateway System Manager Data Flow Diagram

7.1.2 Gateway System Manager Major Interfaces

7.1.2.1 Control/Health/Status

A Control, Health, and Status menu is provided via a TELNET session or via the touch screen.

7.1.2.2 Metro Configuration Index File

This file is used by the Metro CSC. The Gateway System Manager provides the means to load the file onto the SCSI disc. The content of the file is not relevant to the Gateway System Manager.

7.1.2.3 SURFICE Initialization Parameters

This file is used by the Metro CSC. The Gateway System Manager provides the means to load the file onto the SCSI disc. The content of the file is not relevant to the Gateway System Manager.

7.1.2.4 GMS Configuration Index File

This file is used by the GMS CSC. The Gateway System Manager provides the means to load the file onto the SCSI disc. The content of the file is not relevant to the Gateway System Manager.

7.1.2.5 TCID File

This file is used by the CCMS Measurement Extractor/RTCN Packet Builder CSC. The Gateway System Manager provides the means to load the file onto the SCSI disc. The content of the file is not relevant to the Gateway System Manager.

7.1.2.6 FD-To-RTCN ID File

This file is used by the CCMS Measurement Extractor/RTCN Packet Builder CSC. The Gateway System Manager provides the means to load the file onto the SCSI disc. The content of the file is not relevant to the Gateway System Manager.

7.1.2.7 FEP-to-Queue File

This file is used by the CCMS Measurement Extractor/RTCN Packet Builder CSC. The Gateway System Manager provides the means to load the file onto the SCSI disc. The content of the file is not relevant to the Gateway System Manager.

7.2 Front End Process Controller (FEPC) CSCs

There is one FEPCs in the VME Telemetry Processor. The top level data flow diagram for the FEPC is shown below in Figure 7:

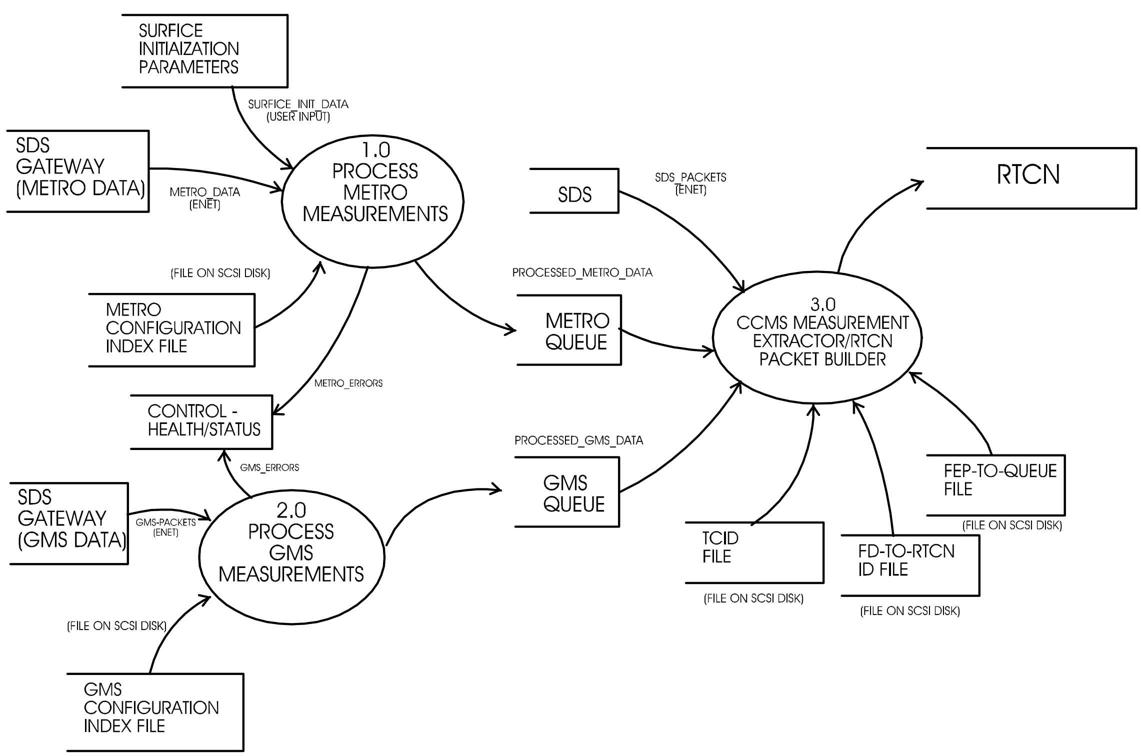

Figure 7: Front End Process Controller Data Flow Diagram

There are three major CSCs running on the FECP: Metro, GMS, and the CCMS Measurement Extractor/RTCN Packet Builder. Each CSC is described in detail in the following sections.

7.2.1 Metro CSC

The Metro CSC provides the mechanism for the integration of the LC-39 Meteorological Data System data into the Shuttle Data Stream. Meteorological data is sent from Remote Terminal Units located at the Pads and SLF to room 2P20 of the LCC. There, it is collected and time stamped by an single board computer where the data is then passed out through an RS-232 port to the SDS Metro Gateway. Each valid data packet is converted first to IEEE floating point, then converted to MODCOMP floating point (or in the case of the CS Gateway - IEEE FP ?), packetized into PCGOAL packets, and passed through a queue to the CCMS Measurement Extractor/RTCN Packet Builder. Additionally, some the meteorological measurements are also passed to a specialized function SURFICE which calculates the predicted rate of ice forming or melting on the External Tank during launch operations. The output of the SURFICE function is also queued to the CCMS Measurement Extractor/RTCN Packet Builder.

7.2.1.1 Metro Data Flow Diagrams

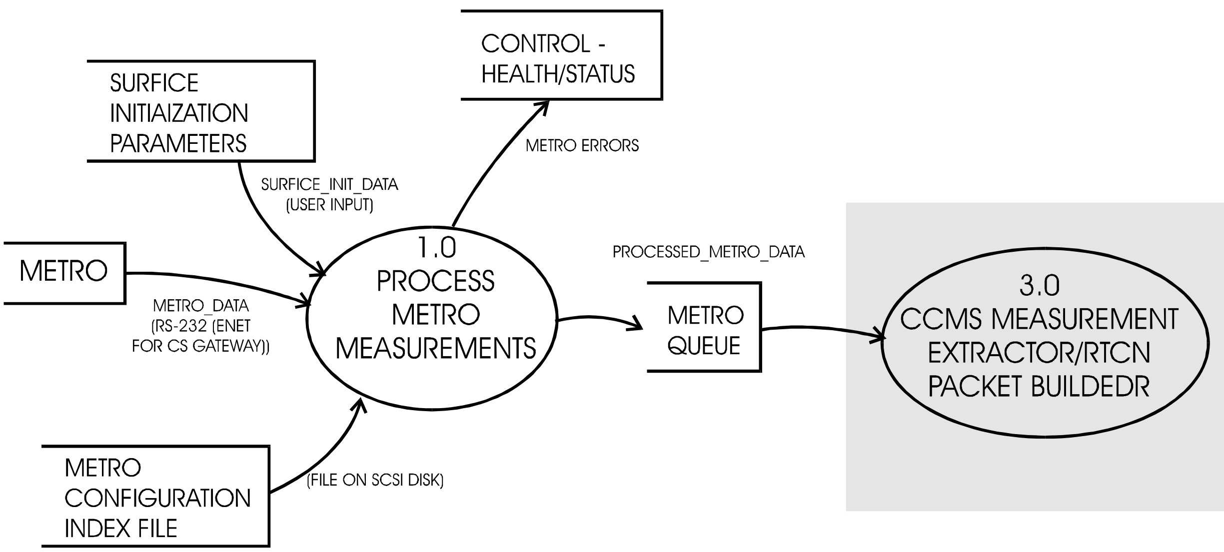

Figure 8: Metro Level 1 Data flow Diagram

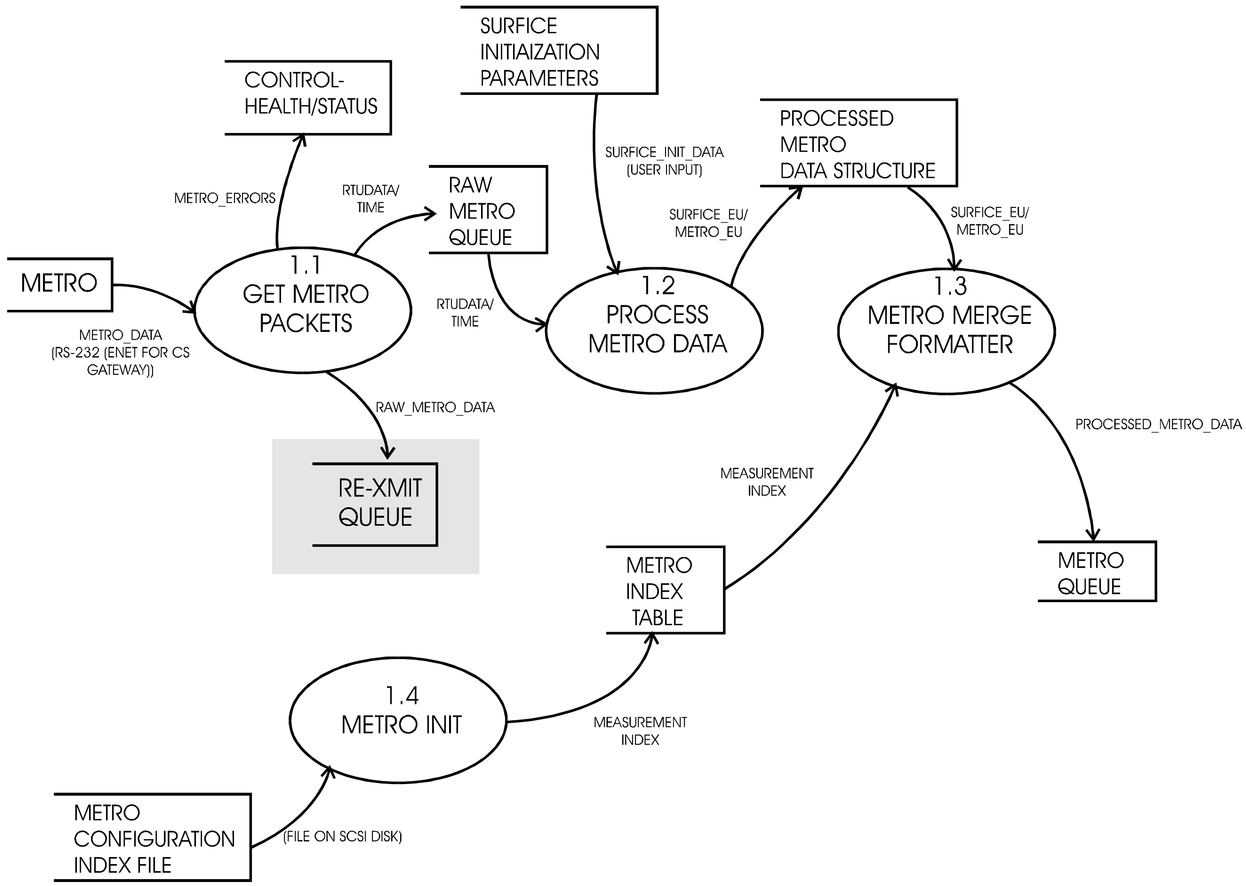

Figure 9: Metro Level 2 Data Flow Diagram

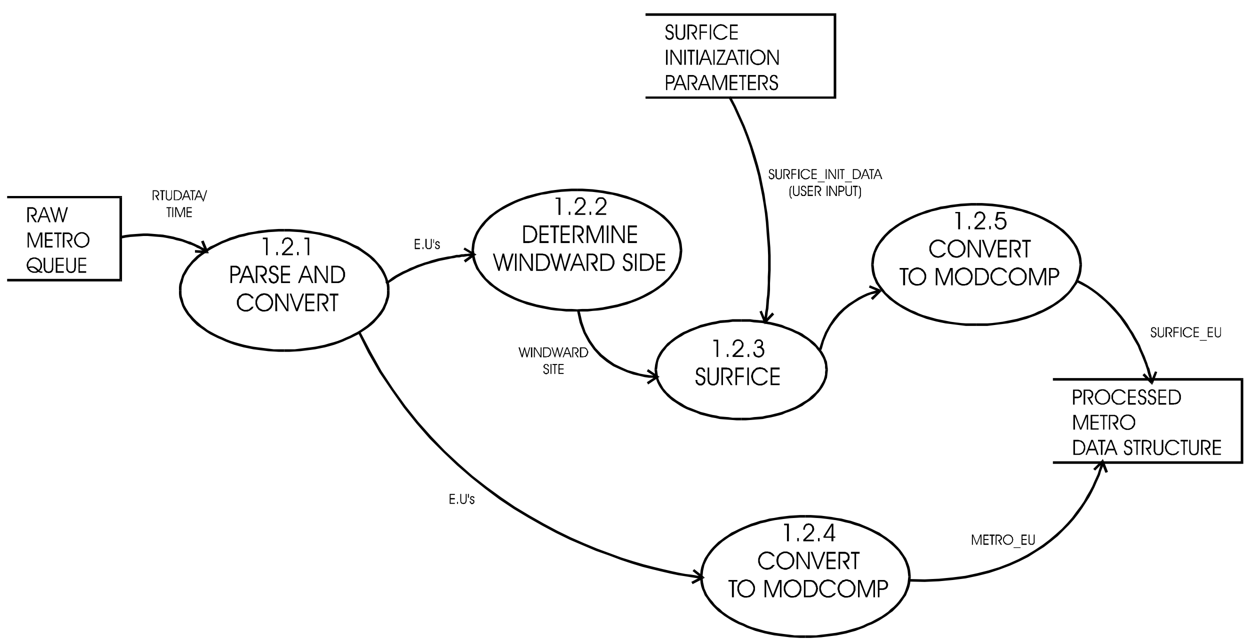

Figure 10: Process Data Level 3 Data Flow Diagram

7.2.1.2 Metro Major Interfaces

7.2.1.2.1 Metro Configuration Index File

The Metro Configuration Index File is ASCII file that contains information about each measurement in the Pad Meteorological System. An index number is assigned to each measurement and is utilized by the SDS CSC to assign a Common Data Buffer Address.

7.2.1.2.2 SURFICE Initialization Parameters

Surfice Initialization parameters contain information about External Tank Foam thickness. The parameters are unique to each flow and are entered at the command line when bringing up an FEPC for support. The parameters are as follows: LO2 Tank OGGIVE, LO2 BARREL, LH2 UPPER BARREL, LH2 LOWER BARREL.

7.2.1.2.3 Re-Transmit CSC

Raw Metro measurements are passed to the Retransmit CSC via a C function call. For more information about the details of this interface, please reference the Consolidated SDS Gateway CSC header file.

7.2.1.2.4 CCMS Measurement Extractor/RTCN Packet Builder

The Metro CSC passes processed data to the CCMS Measurement Extractor/RTCN Packet Builder CSC in the format of PC-GOAL Packets. For more information about the structure of the PC-GOAL packets, reference KSCL-1100-805 (PC-GOAL Design Specification).

7.2.1.2.5 Control/Health/Status

At the present time, no health and status information is provided. It is planned for Post Juno activities. The Control interface is provided via a VxWorks function calls (taskDelete, taskSpawn, etc.) . For more information, see VxWroks Programmers Reference Version 5.2.

7.2.2 GMS CSC

The GMS CSC provides the mechanism for the integration of the LC-39 Ground Measurement System/ Permanent Measurement System data into the Shuttle Data Stream. GMS data is sent from digitizing equipment at each Pad and Mobile Launch Platform (MLP) to a pair of Loral System 550s in the LCC room 2P20. There, measurement data is gathered at a maximum of 2 samples/sec by a pair of Sun workstations and retransmitted via an Ethernet UDP broadcast to the Consolidated SDS Gateway. Data packets are read from each of four ports and converted from non-linearized counts to IEEE floating point notation. The data is then converted to MODCOMP floating point, packetized into PCGOAL packets, and passed through a queue to the Augment SDS Process.

As an interim measure, the UDP broadcast packets will be retransmitted via in a UDP point to point format to support the CLCS Satellite Development Environment (SDE). The Consolidated Systems Gateway will be configured to accept this input format in each of the SDEs.

7.2.2.1 GMS Data Flow Diagrams

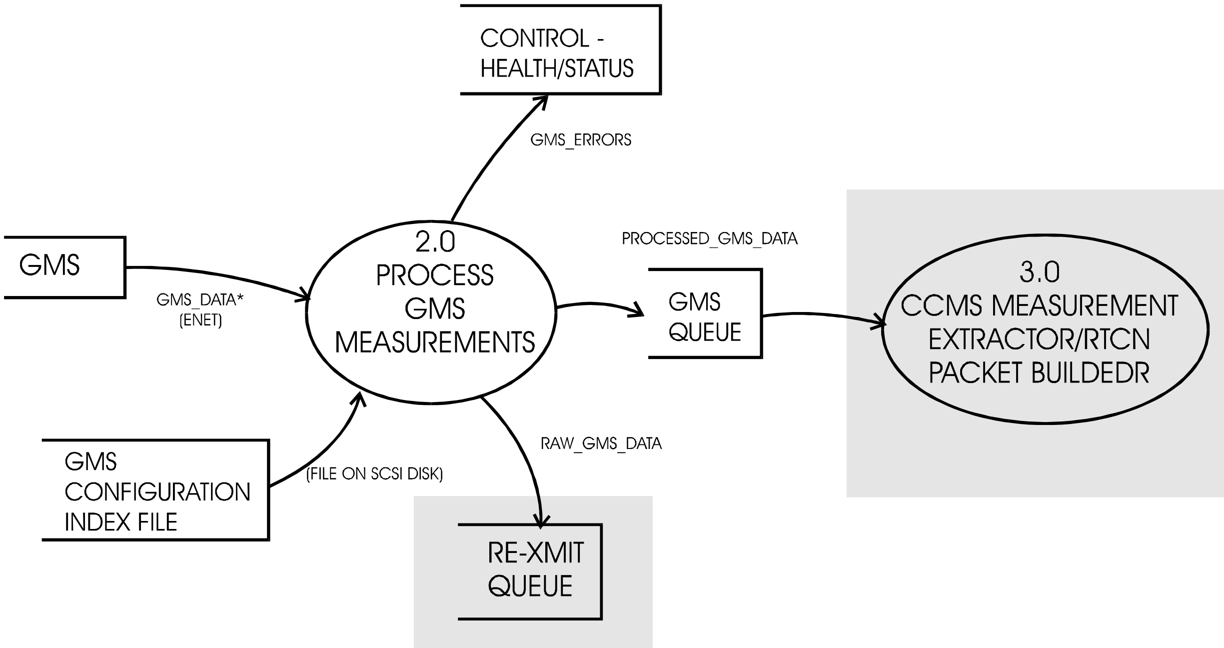

Figure 11: GMS Level 1 Data Flow Diagram

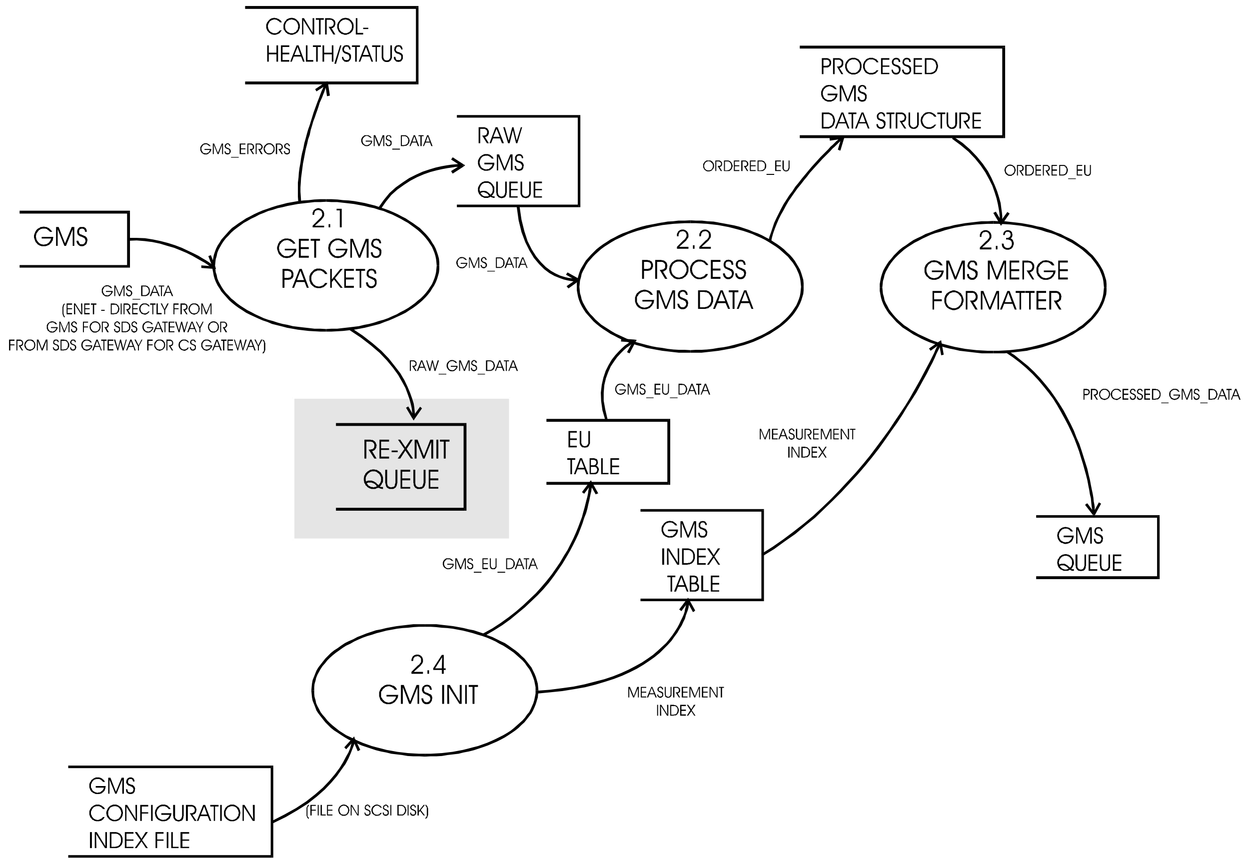

Figure 12: GMS Level 2 Data Flow Diagram

7.2.2.2 GMS Major Interfaces

7.2.2.2.1 GMS System

The Consolidated SDS Gateway receives GMS Data via UDP Broadcast packets. The GMS Packet Structure is defined in the GMS Design Specification.

7.2.2.2.2 GMS Configuration Index File

The GMS Configuration Index File is ASCII file that contains information about each measurement in the GMS System. An index number is assigned to each measurement and is utilized by the SDS CSC to assign a Common Data Buffer Address.

7.2.2.3 CCMS Measurement Extractor/RTCN Packet Builder

The GMS CSC passes processed data to the CCMS Measurement Extractor/RTCN Packet Builder CSC in the format of PC-GOAL Packets. For more information about the structure of the PC-GOAL packets, reference KSCL-1100-805 (PC-GOAL Design Specification).

7.2.2.4 Control/Health/Status

At the present time, no health and status information is provided. It is planned for Post Juno activities. The Control interface is provided via a VxWorks function calls (taskDelete, taskSpawn, etc.) . For more information, see VxWorks Programmers Reference Version 5.2.

7.2.3 CCMS Measurement Extractor/RTCN Packet Builder CSC

The purpose of the CCMS Measurement Extractor/RTCN Packet Builder CSC is to extract data from the SDS or SDS', Metro System, and GMS System. The CSC will place the data into separate RTCN data streams, based on the originating FEP or data provider.

The CCMS Measurement Extractor/RTCN Packet Builder CSC will receive data from a single multicast SDS or SDS' data stream. The CSC will break the data stream into component parts based on FEP (based on the FEP-to-Queue File). The Common Data Buffer address will be replaced with the RTCN FDID (status, health, 100usec tag, address, etc.) and the measurement will be placed in a queue based on FEP. (Individual discretes will be placed in the queue separately.) The RTCN queues will be output periodically, (using the Network Services CSCI.) based on timers as follows:

1) All DDP queues will be output based on timers (one timer per queue) that are normally 10msec, but can be varied from 5msec to 100msec.
2) The Consolidated-10 queue will be output as a single stream based on a timer that is normally 10msec, but can be varied from 5msec to 100msec.
3) The Consolidated-100 queue will be output as a single stream based on a timer that is normally 100msec, but can be varied from 50msec to 1 second.

7.2.3.1 CCMS Measurement Extractor/RTCN Packet Builder Data Flow Diagram

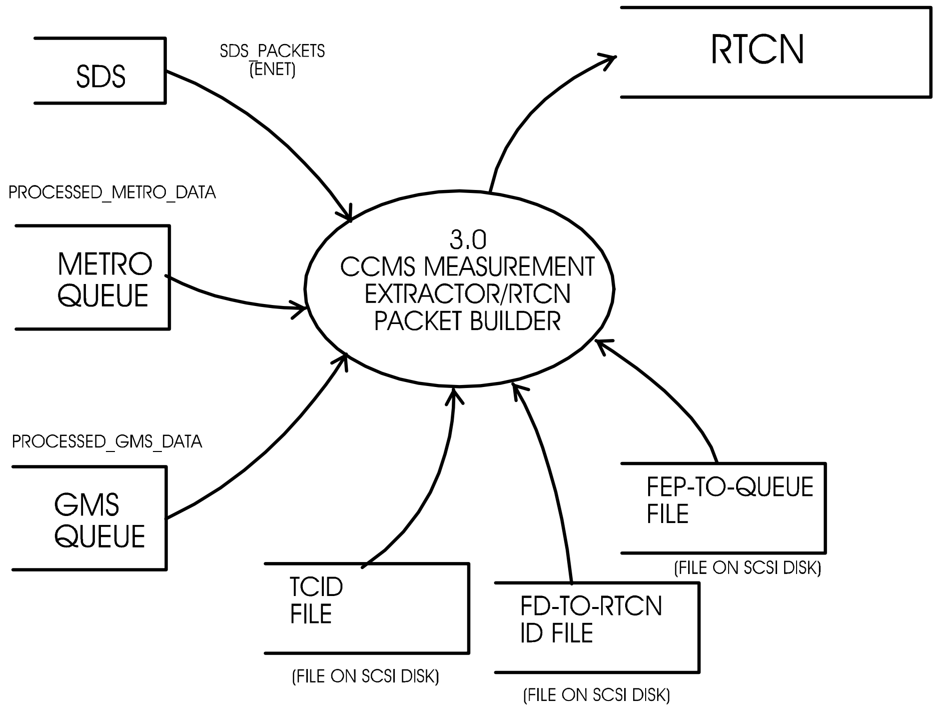

Figure 13: CCMS Measurement Extractor/RTCN Packet Builder Level 1 Data Flow Diagram

7.2.3.2 CCMS Measurement Extractor/RTCN Packet Builder Major Interfaces

7.2.3.2.1 Control/Health/Status

At the present time, no health and status information is provided. It is planned for Post Juno activities. The Control interface is provided via a VxWorks function calls (taskDelete, taskSpawn, etc.) . For more information, see VxWorks Programmers Reference Version 5.2.

7.2.3.2.2 TCID File

The TCID file is defined in KSC-LPS-IB-070-21 Part III. This file is used to initialize the SDS CCMS Measurement Extractor/RTCN Packet Builder.

7.2.3.2.3 FD-to-RTCN ID File

This file is part of the TCID File and provides the CLCS TCID in the CPU Distribution Mask Field. For more information about this file, reference the CCMS Measurement Extractor/RTCN Packet Builder header file.

7.2.3.2.4 Fep-to-Queue ID File

This file provides initialization data to the CCMS Measurement Extractor/RTCN Packet Builder and determines which streams and which FEP logical ports are to be placed in these streams. For more information about this file, reference the CCMS Measurement Extractor/RTCN Packet Builder header file.

7.2.3.2.5 Shuttle Data Stream (SDS)

PC-GOAL Packets are received via the SDS. For more information about the structure of the PC-GOAL packets, reference KSCL-1100-805 (PC-GOAL Design Specification).

7.2.3.2.6 Metro CSC

The Metro CSC passes processed data to the CCMS Measurement Extractor/RTCN Packet Builder CSC in the format of PC-GOAL Packets. For more information about the structure of the PC-GOAL packets, reference KSCL-1100-805 (PC-GOAL Design Specification).

7.2.3.2.7 GMS CSC

The GMS CSC passes processed data to the CCMS Measurement Extractor/RTCN Packet Builder CSC in the format of PC-GOAL Packets. For more information about the structure of the PC-GOAL packets, reference KSCL-1100-805 (PC-GOAL Design Specification).

7.2.3.2.8 RTCN

The CCMS Measurement Extractor/RTCN Packet Builder CSC will generate a payload packet the conforms to the JUNO Jamieson RTCN Packet Definition. For more information about the RTCN Packet definition, reference the RTCN CLCS Payload Packet Design Document JUNO Rev. 1 (02/12/97).

7.2.4 CLCS FDID Builder CSC

The CLCS FDID Builder generates a file used by the CLCS Consolidated Systems Gateway to assign CLCS FDIDS. The CSC runs off-line on a personal computer.

7.2.4.1 CLCS FDID Builder Data Flow Diagrams

TBD

7.2.4.2 CLCS FDID Builder Major Interfaces

7.2.4.2.1 TCID File

The TCID file is defined in KSC-LPS-IB-070-21 Part III. This file is used to initialize the SDS CCMS Measurement Extractor/RTCN Packet Builder.

7.2.4.2.2 FD-to-RTCN ID File

This file is part of the TCID File and provides the CLCS TCID in the CPU Distribution Mask Field. For more information about this file, reference the CCMS Measurement Extractor/RTCN Packet Builder header file.

7.3 Consolidated SDS Services Structure Diagram

- Gateway System Manager

- Metro Process
    - Metro Init
    - Get Metro Packets
    - Process Data
        - Parse and Convert
        - Determine Windward Side
        - SURFICE
        - Convert to Mod-Comp
    - Metro Merge Formatter
- GMS Process
    - GMS Init
    - Get GMS Packets
    - Process GMS Data
    - GMS Merge Formatter
- CCMS Measurement Extractor/RTCN Packet Builder
    - CCMS Measurement Extractor/RTCN Packet Builder Init
    - Acquire SDS
    - Acquire Metro/GMS
    - Transmit CCMS/Metro/GMS Packets

8. Unit Test Plan

For JUNO, the Consolidated Systems Gateway will be tested to verify the content of the RTCN packets over Ethernet with test programs. In mid March, the ATM RTCN packet will be verified during integration testing in the SDE. PC-Goal Displays will used in conjunction with new CLCS displays to verify the content of the data.